

REQUEST FOR RECONSIDERATION

Conventional gas phase oxidations of propene to acrolein attempt to achieve a high yield of acrolein (e.g.,  $Y^{AC}$ ) (page 1, lines 30-34). Prior art processes may achieve high acrolein yield by conducting the prior art catalytic oxidation reaction under a high space time yield condition (i.e., wherein a large amount of a reaction starting gas mixture for oxidation is forced through a reactor) and by using a higher temperature secondary stage oxidation zone. In the prior art processes acrolein yield and throughput are concurrently maximized.

This strategy has an accompanying disadvantage. This point is described on page 3, lines 6-15 of the specification which states the following:

However, a disadvantage of the teachings of the prior art is that they are exclusively directed towards operating a multizone arrangement under a high propene loading. This is disadvantageous in that such a procedure is inevitably accompanied by a high  $STY^{AC}$ . This assumes a corresponding market demand for acrolein and/or acrylic acid. When the latter is not present (for example temporarily), the multizone arrangement necessarily has to be operated at lower propene loadings, and the target quantity to be pursued which then also comes to the forefront is a very high selectivity of acrolein formation, based on converted propene ( $S^{AC}$ ). On single pass through the multizone arrangement, this is the molar amount of acrolein formed, based on the number of moles of propene converted.

Applicants have described a process that achieves both high conversion of propene to acrolein with high selectivity at low hourly space velocities of propene (e.g.,  $< 160$  l). Thus the process described in the present specification may be run at lower propene loadings (e.g., during times of low market demand) without sacrificing the selectivity and/or efficiency of the process and without forming greater quantities of undesirable side products.

Applicants have disclosed that improved selectivity can be obtained by carrying out the oxidation of propene in a multizone environment where the propene/oxygen gas mixture is passed through a first reaction zone that is maintained at a higher maximum temperature than a subsequent reaction zone. Applicants have demonstrated the advantages of the

invention process in the Examples of the specification. The table on page 24 of the specification summarizes the results of Applicants' experiments. The table is reproduced below for convenience:

Propene hourly space velocity (I (STP)/l•h)	T <sub>A</sub>	T <sub>B</sub>	T <sup>maxA</sup>	T <sup>maxB</sup>	C <sub>PA</sub>	C <sub>PB</sub>	S <sub>AC</sub>	S <sub>AA</sub>
130 (E)	319	319	384	351	66.7	95.1	92.6	5.1
130 (E)	327	313	400	330	70.3	94.8	93.9	4.4
130 (C)	311	325	361	372	60.8	95.0	90.9	6.2
185 (C)	322	336	380	368	64.5	94.9	90.6	7.4
185 (C)	310	344	353	383	57.2	95.2	89.2	8.1

(Shaded rows are inventive)

The table illustrates an important point regarding the present invention; namely, T<sup>maxB</sup> should be lower than T<sup>maxA</sup> to achieve improved selectivity while maintaining good conversion at relatively lower throughput (e.g., lower propene hourly space velocity). One way to control the T<sup>maxB</sup> and achieve a lower T<sup>maxB</sup> is by reducing the hourly space velocity of propene. By reducing the amount of propene available for oxidation the amount of heat generated by the oxidation will be less and therefore it follows that the T<sup>max</sup> will not be as high as would otherwise be the case for higher propene loading. Therefore, temperature control is not only a function of bath temperature (e.g., T<sup>A</sup> and/or T<sup>B</sup>) but may also be a function of propene throughput.

The table contains two inventive examples wherein the hourly space velocity of propene is less than 160 l and the maximum temperature of a first reaction zone is lower than the maximum temperature of a second reaction zone (i.e., T<sup>maxB</sup> is less than T<sup>maxA</sup>). The data in the Table show that a process conforming to the present claim limitations provides good conversion (C<sub>PB</sub>) and selectivity (e.g., S<sub>AC</sub> which shows that acrolein is formed at a greater selectivity in the invention process).

Applicants have therefore shown that by decreasing the propene loading of a reaction, and maintaining the maximum temperature of a first oxidation zone higher than the

maximum temperature of a second oxidation zone, improved selectivity of acrolein formation may be obtained in contradiction to conventional practice.

The Office variously rejected the present claims under obviousness-type double patenting and obviousness under the meaning of 35 U.S.C. § 103(a) in view of a patent to Arnold (U.S. 6,395,936).

Arnold strives for a high space time yield. By operating at high propene loading Arnold is able to achieve high conversion at reasonable selectivity. Arnold may maintain the bath temperature for a zone A at a temperature that is lower than the temperature of a zone B (e.g., the temperature of zone A is at least 5°C preferably at least 10°C lower than the temperature of zone B). Arnold states:

b) the fixed-bed catalyst consists of a catalyst bed arranged in two spatially successive reaction zones A, B, the temperature of the reaction zone A being from 300 to 390°C (frequently to 350°C ) and **the temperature of the reaction zone B** being from 305 to 4200°C (frequently up to 380°C ) and at the same time **being at least 5°C above** the temperature of the reaction zone A,

This Arnold teaches that the prior art process must have a zone B temperature “at least 5°C greater than” a zone A temperature. Applicants submit that this condition is directly contradictory to the claimed invention wherein the  $T^{\max A}$  must be greater than the  $T^{\max B}$ .

Moreover, the Office admits that Arnold teaches a process “wherein the gas starting mixture is passed with a propene loading of greater than or equal to about 160 l (STP)/l•h” (see second full paragraph on page 3 of the Office Action). The Arnold process is explicitly described to be carried out at a propene loading of greater than or equal to 160 l (STP) l•h on a fixed-bed catalyst (column 3, lines 38-41). The Arnold patent explicitly discloses that higher propene loads are favored:

The higher the chosen propene loading of the catalyst bed in the novel process, the greater should be the chosen difference between the temperature of the reaction zone A and the temperature of the reaction zone B.... (column 3, lines 65-67).

Surprisingly, the abovementioned applies not only in the case of propene loadings of the catalyst bed of  $\geq 165$  ...;  $\geq 170$  ...;  $\geq 175$  ...; or  $\geq 180$  ...; but also in the case of propene loadings of the catalyst bed of  $> 185$  ... or  $\geq 190$ ;  $\geq 200$  ... (column 4, lines 14-17).

Therefore Arnold explicitly favors high propene loading (e.g., 160 l or above). There is no suggestion in Arnold that improved selectivity of acrolein formation can be realized by lowering the amount of the propene conducted through the fixed catalyst bed. Therefore the present claim limitation that the propene loading must be  $< 160$  l (STP) l•h is directly contradictory to the disclosure of Arnold which states that the propene loading must be  $\geq 160$  l (STP) l•h and further states that improved performance is obtained by increasing beyond 160 l (STP) l•h. Arnold explicitly teaches away from the presently claimed invention. The combination of Arnold with Takata to render the presently claimed invention obvious makes no sense because Arnold explicitly directs those of skill in the art away from the presently claimed invention (e.g., propene throughput  $< 160$  l (STP) l•h) .

With respect to the obviousness-type double patenting rejection, the Office relies upon the incorrect reasoning that a prior art process that requires high propene loading can render obvious a process that requires a propene loading excluded by the prior art. The Office states the following:

Although the conflicting claims are not identical, they are not patentably distinct from each other because the main difference is that the US Patent conducts the oxidation process at an hourly space velocity of at least 160 l (STP) of propene per liter of catalyst, while the instant process is conducted at an hourly space velocity between 90 and 160 l (STP) per liter of catalyst. However, the U.S. Patent teaches that various propene loadings have been known to be employed in such processes. Therefore, it would have been obvious to a person of ordinary skill in the art to modify the hourly space velocity of greater than or equal to 160, to a loading that is higher or lower than the number in order to obtain an optimal feed ratio of propene through the fixed bed catalyst, so as to afford optimal conversion of propene and selectivity of acrolein. (Paragraph bridging pages 4 and 5 of the Office Action).

Applicants submit that the Office's statement is contradictory on its face. Arnold describes a process that requires the propene loading to be  $\geq 160$  l (STP) l•h. Arnold describes at column 2, lines 7-41 problems that the Arnold process is meant to overcome. Arnold overcomes the prior art processes by, *inter alia*, increasing the propene hourly space velocity (e.g., throughput).

Thus Arnold teaches that lower propene loadings are not favored and that lower propene loadings cannot provide optimal conversion of propene or selectivity of acrolein formation. In fact, Arnold teaches that one must increase propene loading if one wants to improve propene acrolein selectivity. Further, as stated above, Arnold teaches that the temperature of a second reaction zone should be greater than the temperature of a first reaction zone.

The claimed process provides improved selectivity of acrolein formation at decreased throughput (e.g., hourly space velocity  $< 160$  l) at a  $T^{\max A}$  that is greater than a  $T^{\max B}$ . Applicants submit that such a process would not have been foreseen in view of Arnold's explicit teaching away from hourly space velocities of  $< 160$  l and further explicit teaching favoring  $T_B$  temperatures greater than  $T_A$  temperatures.

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Reply to Office Action of May 19, 2005

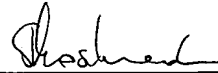
Applicants submit the obviousness rejections of the Office Action of May 19, 2005 are not supportable and should be withdrawn. Applicants respectfully request the withdrawal of the rejections and the passage of all now-pending claims to allowance.

Respectfully submitted,

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